

1. A capacitive takeoff swimming sensor system, the system comprising:

- a. a sensor mat;
- b. a sensor circuit in electrical communication with the sensor mat;
- c. a power supply; and,
- d. wherein the sensor mat, sensor circuit and power supply together detect takeoff of a swimmer from the sensor mat by monitoring change in capacitance level in a swimmer occupiable region along the surface of the sensor mat.

2. The capacitive takeoff swimming sensor system of claim 1, wherein th sensor mat is situated upon a starting platform.

5 3. The capacitive takeoff swimming sensor system of claim 2, wherein the starting platform is a relay takeoff swimming platform.

10 4. The capacitive takeoff swimming sensor system of claim 1, wherein a portion of the sensor mat is substantially vertically oriented for physical and capacitive contact with at least a portion of a toe of the swimmer.

5 5. The capacitive takeoff swimming sensor system of claim 1, wherein a portion of the sensor mat is substantially horizontally oriented for physical and capacitive contact with at least a portion of a foot of the swimmer.

15 6. The capacitive takeoff swimming sensor system of claim 1, wherein a portion of the sensor mat is substantially vertically oriented for physical and capacitive contact with at least a portion of a toe of the swimmer and a contiguous portion of the sensor mat is substantially horizontally oriented for physical and capacitive contact with at least a portion of a foot of the swimmer.

20 7. The capacitive takeoff swimming sensor system of claim 1, wherein a portion of the sensor mat is substantially vertically oriented for physical and capacitive contact with at least a portion of a toe of the swimmer and another portion of the sensor mat, continuous with the vertical portion of the sensor mat, is substantially horizontally oriented for physical and capacitive contact with at least a portion of a foot of the swimmer.

8. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor mat has a textured non-slip surface for physical and capacitive contact with the swimmer.

5 9. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor mat includes a sensor electrode to monitor capacitance in a swimmer occupiable region along a surface of the sensor mat.

10 10. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor mat includes multiple layers.

11. The capacitive takeoff swimming sensor system of claim 10, wherein the multiple layers of the sensor mat are bonded.

15 12. The capacitive takeoff swimming sensor system of claim 11, and wherein the multiple layers of the sensor mat are bonded by adhesive.

13. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor mat is a laminate structure.

20 14. The capacitive takeoff swimming sensor system of claim 13, wherein the sensor mat laminate structure includes, in order, a conductive exterior layer, an insulative layer, a conductive sense electrode layer, an insulative layer, a conductive ground electrode layer, and an insulative layer.

25 15. The capacitive takeoff swimming sensor system of claim 14, wherein the conductive exterior layer includes a textured non-slip surface.

16. The capacitive takeoff swimming sensor system of claim 13, wherein the sensor mat laminate structure can assume a non-planar shape.

30 17. The capacitive takeoff swimming sensor system of claim 13, wherein the sensor mat laminate structure has

alternating electrical conductor, electrode, and electrical insulator layers.

18. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor circuit in electrical communication with the sensor mat includes a charge-transfer touch integrated circuit.

19. The capacitive takeoff swimming sensor system of claim 18, wherein the charge-transfer touch integrated circuit is a QT310 capacitive sensor IC from Quantum Research Group.

20. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor circuit in electrical communication with the sensor mat includes a charge-transfer touch integrated circuit and the sensor mat includes a conductive sense electrode and further wherein the charge-transfer integrated circuit fosters projection of a capacitive sense field around the conductive sense electrode.

21. The capacitive takeoff swimming sensor system of claim 1, wherein the sensor mat includes a conductive sense electrode layer and a conductive ground electrode layer and wherein the sensor circuit includes a capacitive monitor circuit connected to the conductive sense electrode layer and the conductive ground electrode layer, the capacitive monitor circuit including a charge-transfer touch integrated circuit and a sampling capacitor.

22. The capacitive takeoff swimming sensor system of claim 21, wherein the sampling capacitor is selected to provide desired sensitivity relative to the capacitance across the sensing mat.

23. The capacitive takeoff swimming sensor system of claim 1, wherein the power supply is an approximately 2.6 volt regulated power supply.

24. The capacitive tak off swimming sensor system of claim 1, wherein the power supply is a battery circuit.

25. The capacitive takeoff swimming sensor system of claim 24, wherein the battery circuit includes a lithium battery.

26. The capacitive takeoff swimming sensor system of claim 1, wherein the power supply includes an approximately 2.6 volt regulated power supply and a battery circuit sampling capacitor is selected to provide desired sensitivity relative to the capacitance across the sensing mat.

27. The capacitive takeoff swimming sensor system of claim 1, further comprising a test circuit including a test switch and a light emitting diode to indicate performance of a successful test.

28. The capacitive takeoff swimming sensor system of claim 1, wherein the power supply includes an approximately 2.6 volt regulated power supply and a battery circuit, the battery circuit supplying power when the voltage from the regulated power supply is detected as insufficient.

29. The capacitive takeoff swimming sensor system of claim 28, further comprising a test circuit including a test switch and a light emitting diode to indicate performance of a successful test, the test circuit normally being supplied by the battery circuit.

30. The capacitive takeoff swimming sensor system of claim 1, wherein the capacitive takeoff swimming sensor system is one of a plurality of like sensor systems, each of the capacitive takeoff swimming sensor systems of the plurality dedicated to a single individual swimming lane in a multi-laned swimming pool and each providing swimmer takeoff information to a interconnected control system having optional

capabilities for timing, relay touchpad previous swimmer lane information, scoreboard display, and starting.

31. A capacitiv relay takeoff swimming platform sensor system, the system comprising:

a. multiple-like components stationed and arranged along and at the ends of multiple swimming pool lanes used for timing of relay swimming events; and,

b. means for comparing timing from the multiple like components to electronically detect false starts by second and subsequent swimmers in each lane based upon capacitive changes resulting from takeoff.

32. The capacitive relay takeoff swimming platform sensor system of claim 31, wherein the takeoff detection is substantially pressure insensitive.

33. A capacitive relay takeoff swimming platform sensor system, the system comprising:

a. at least one swimming lane station having a relay takeoff swimming platform, the at least one swimming lane station including:

(1) a sensing mat on the relay takeoff swimming platform;

(2) a sensor circuit closely located to the sensing mat;

(3) a cable connecting the sensor circuit to a lane module; and,

(4) a touchpad including a touchpad sensor mounted on the swimming pool at the lane end being connected to the lane module by another cable; and,

b. a timer connected to the lane module by yet another cable.

34. The capacitive relay takeoff swimming platform sensor system of claim 33, wherein the timer is connected to a start system.

5 35. The capacitive relay takeoff swimming platform sensor system of claim 33, wherein the timer is connected to a scoreboard.

10 36. The capacitive relay takeoff swimming platform sensor system of claim 33, wherein the lane module receives timing information when a contact is detected at the touchpad sensor and wherein the lane module receives timing information when a takeoff is detected at the sensing mat.

15 37. The capacitive relay takeoff swimming platform sensor system of claim 36, wherein the timing of the detected contact and the detected takeoff are compared against a pre-set disqualification criterion.

38. The capacitive relay takeoff swimming platform sensor system of claim 37, wherein the pre-set disqualification criterion is a detected takeoff preceding a detected contact by 0.03 second.

20 39. The capacitive relay takeoff swimming platform sensor system of claim 37, wherein the satisfaction of the pre-set disqualification criterion results in generation of an alarm signal.

25 40. The capacitive relay takeoff swimming platform sensor system of claim 37, wherein the at least one swimming lane station having a relay takeoff swimming platform, is one of a plurality of swimming lane stations, all electrically communicating with the timer and are employed for conducting starts and finishes at each swimming lane station and for
30 analyzing data at the relay takeoff swimming platforms with respect to the arrivals of first relay swimmers at the pool

edg s and the departures of second relay swimmers at the relay takeoff swimming platforms.

5 41. The capacitive relay takeoff swimming platform sensor system of claim 37, further comprising a scoreboard connected as part of the system to annunciate swimming event elapsed times or other data as desired.

42. A method of timing swimming relays, the method comprising the steps of:

- a. providing a swimming lane station with a sensing mat and a touchpad sensor at a lane end associated with the swimming lane station;
- b. sensing arrival of a first relay swimmer by contact with the touchpad sensor mounted on the associated swimming pool lane end; and,
- c. sensing departure of a second relay swimmer from the relay takeoff swimming platform by the sensing mat.

43. The method of claim 42, wherein sensing the second relay swimmer departure is includes sensing a capacitance level change at the sensing mat.

5 44. The method of claim 43, wherein an integrated circuit is incorporated with adjoining circuitry contained in a housing mounted adjacent to one edge of the sensing mat to sense the capacitance level and the influence thereof adjoining the upper region of the sensing mat.

10 45. The method of claim 44, wherein the sensing mat is constructed of multiple layers, the layers including protective layers, electrically insulative layers, and electrically conductive layers which are opposed and form sensor electrodes.

15 46. The method of claim 45, wherein a sensor electrode is incorporated to monitor the capacitance of the region at the upper region of the sensing mat.

20 47. The method of claim 46, wherein monitored capacitance is varied by the departure of the second relay swimmer from the relay takeoff swimming platform, and such capacitance variation is detected by the integrated circuit to denote and relay the departure of the second relay swimmer.

25 48. The method of claim 47, further comprising the step of electronically closing a switch to compare the departure time of the second relay swimmer to the arrival time of the first relay swimmer by the connected timer.